

Exploring and managing digital innovation in Teaching Hospitals.

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Abstract

The rising use of messaging applications such as WhatsApp for both social and personal purposes, has determined an increasing widespread of the use of these technologies even in healthcare contexts. Previous research has mainly focused on individual variables which determine the use of WhatsApp rather than on the relationship between individual and organizational variables.

This study is based on a theoretical framework that combines institutional and individual factors to explain the adoption of WhatsApp as a communication channel with peers (other healthcare professionals) or with patients. Data have been collected through a survey administered to physicians and nurses in an Italian University Hospital in Rome.

A total of 191 high-quality responses had been received. Results show that WhatsApp is widely used in Hospital setting by nurses and physicians, and that an interplay exists between institutional and individual factors in determining the use of this technology. In particular, individual factors play a key role as determinant of the use of WhatsApp; in fact, perceived usefulness is directly related to the use of WhatsApp with patients and colleagues ($p=0,022$). Instead, institutional factors play a secondary role; they do not have a direct influence on the use of WhatsApp, but they always act through individual factors. The study provides hospital managers with information on factors that promote / inhibit the adoption of "back door" innovations such as WhatsApp, these can help them manage these phenomena by implementing appropriate strategies to limit potential risks and misbehavior.

Introduction

The rising use of messaging applications such as WhatsApp for both social and personal purposes, has determined an increasing widespread of the use of these technologies even in healthcare contexts (Mobasheri MH, 2015; Wolf JA, 2013; Haffey F 2013; Martinez-Perez B, 2015; Dorwal P, 2016; Gulacti U, 2016). A growing number of healthcare professionals have adopted WhatsApp in their daily work in order to share information with each other and with patients (Gulacti U, 2016; Johnston MJ, 2015; Wani SA, 2013; Giordano V, 2015; Astarcioglu MA, 2015; Giordano V, 2017). Past research highlighted the advantages and disadvantages of using WhatsApp in healthcare settings. In particular, two positions appear to coexist in the scientific debate: those that expose and underline all the positive aspects of the phenomenon through empirical studies (Gulacti U, 2016; Johnston MJ, 2015; Wani SA, 2013; Giordano V, 2015; Astarcioglu MA, 2015; Giordano V, 2017; Lee RS, 2008; Raiman L, 2017; Kaliyadan F, 2016 Boulos MNK, 2016; Jagannathan M, 2013), and those that highlight also the negative aspects, linked in particular to the clinical risk for patients and the data security and privacy protection (Wani SA, 2013; Jagannathan M, 2013; Khanna V, 2015; Choudhari P, 2014; Migliore M, 2015; Dhuvad JM, 2015; Pandian SS, 2014). Some of the main advantages of using WhatsApp in healthcare settings are the following: improvement over voice only communication (Petruzzini M, 2016); a computer not required (Kelahmetoglu O,

2015; Suliman MT, 2014); faster than email (Gulacti U, 2016; Boulos MNK, 2016); permits immediate response (Dhuvad JM 2015; Graziano F, 2015); ameliorates surgery performance (Martyn-Hemphill C, 2015); reduces consultation time (Graziano F, 2015; Martyn-Hemphill C, 2015); flattens hierarchy (Wani SA, 2013); encourages junior doctors to seek help (Watson L, 2016); improves team perception of effectiveness (Migliore M, 2015). On the other hand even existing risks or disadvantages are reported: frequent interruption (Gulacti U, 2016; Choudhari P, 2014) disparity in the sense of urgency (Choudhari P, 2014); worsens professional relationships (Choudhari P, 2014); leads to unprofessional behavior (Choudhari P, 2014); requires staying online 24 hours a day (Jagannathan M, 2013; Migliore M, 2015); unable to print a record of chat (Jagannathan M, 2013); not part of the medical records (Jagannathan M, 2013; Migliore M, 2015); difficulty identifying patients in chats (Jagannathan M, 2013; Migliore M, 2015); NHS against instant messaging (Dhuvad JM, 2015); possible issues of privacy and confidentiality (Dhuvad JM, 2015); increased work using WhatsApp (Gulacti U, 2016); risk of reducing autonomy of junior doctors (Wani SA, 2013). Despite the many benefits, WhatsApp is used by professionals without political strategies, and the adoption took place without any previous discussion on the topic. This phenomenon is very particular, especially considering the importance given to the Evidence Based approach in the healthcare context. Moreover, is peculiar that, if in the last few years there has been a great deal of attention to privacy, to the protection of sensitive data, to safety in medical records and information systems and to the Health Technology Assessment, on the other hand, a pervasive and rapid diffusion of uncontrolled and unregulated instruments is occurring. The use of WhatsApp in healthcare setting can be considered as an extreme case of “back-door adoption”; that is the case of technologies that are so easy to use that they are diffused without a discussion or a prior policies definition. Furthermore, this phenomenon could be particularly dangerous because of its speed and uncontrolled spread in a very peculiar and complex context, where even small process’s variables can negatively and harmfully affect clinical risk for patients. Previous research has mainly focused on individual variables rather than on relationship between individual and organizational variables, or on how to integrate the organization’s goals with the goals of individual practitioners. Hospitals are increasingly looking at strategies and guidelines on how digital innovations enabled by smartphones and Apps should be adopted and used to improve care delivery; however, there is still very limited evidence about the individual and organizational determinants that might trigger or inhibit the use of WhatsApp in Hospital setting, and which variables the Governance can exploit to guide professionals’ behaviors.

1.1 Research objectives

The main objective of the study is to understand if and how individual and organizational determinants are combined, so that the Chief Executive Officers and Chief Information Officers have the elements to guide an effective and safe management of WhatsApp usage by healthcare professionals. In particular, the research objective has been turned into the following more focused research questions: Which are the determinants (both individual and/or institutional) of the use of WhatsApp in hospital setting? Is there an interplay between individual and institutional variables? Which is the way WhatsApp is used in hospital setting by physicians and nurses with patients and between colleagues? Which are the main perceived benefits and threats concerning the use of WhatsApp in hospital setting, by physicians and nurses?

2. Material and methods

2.1 Theoretical background and theoretical model

In order to evaluate the interplay between individual and organizational variables, it has been necessary to create a theoretical model that could explain this phenomenon (Fig. 1). In particular, two main theory have been considered: Technology Acceptance Model (TAM), widely used in the last decades in healthcare setting in order to understand what leads people to accept or reject Information Technology, and Institutional Theory, a model that assesses if and how organizational variables drive behavior of professionals.

2.1.1 Tam Model

The TAM model was introduced for the first time by Davis (Davis F, 1989). The main problem that the author has raised was to understand what leads people to accept or reject Information Technology. In this regards, two main variables have been identified: the perceived usefulness and the ease of use. Perceived usefulness measures “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis F, 1989), and therefore induces individuals to use technology as it allows to obtain better results. On the other hand, the ease of use measures “the degree to which a person believes that using a system would be free of effort” (Davis F, 1989; Moore G 1991) and induces the potential users to use a certain technology since it requires low energy expenditure while it may bring advantages.

However, this model has some limitations, in fact TAM does not consider the social context but only the perceptions of the individual. For this reason, over time many models have been developed starting from TAM, but even in these ones the unintentional behavior such as that imposed through rules or cultural factors, is not taken into consideration. In this study we decided to study only the variable “perceived usefulness” because we considered that all the physicians and nurses included in the study use smartphone and WhatsApp daily, so we excluded any problems related to digital divide.

2.1.2 Institutional Theory

Institutional theory refers to a line of organizational research that recognize the significant organizational effects that are associated with the increase of cultural and social forces. According to Scott (Scott WR, 1987; Scott WR, 2001; Scott WR, 2008), “Institutions are made up of cultural-cognitive, normative and regulative elements, which together with associated activities and resources offer stability and meaning to social life.” These three forces are present in totally developed institutional systems, with economists and political scientists placing emphasis on regulative, sociological and normative factors, and anthropologists and organizational theorists placing emphasis on cognitive-cultural factors. According to this perspective, individuals are embedded in institutional pillars that limit the scope of their rational assessment, and direct the engagement of specific behaviors (Scott WR, 1987; Scott WR, 2001; Scott WR, 2008). Scott defines the three institutional pillars as follows (Scott WR, 1987; Scott WR, 2001; Scott WR, 2008): regulative pillars: which regard the existence of regulations, rules and processes whose breach is monitored and sanctioned; normative pillars: which introduce a social dimension of appropriate behaviors in the organization; cultural pillars: which emphasize the use of common schemas, frames, and other shared symbolic representations that create attachment to the ‘appropriate’ behavior. The three pillars model can be used to identify the association between institutional factors and technology adoption, providing a new perspective to research about the technology diffusion, and the TAM can be extended with these three factors as external stimuli, which influence perceived usefulness, to understand the adoption.

2.2 Theoretical Model

Coherently with past research on user acceptance models (Agarwal R, 1999; Morris MG 2000), we added to the defined theoretical model some control variables that are considered able to affect the results: risk perception, age, seniority, clinical specialties and profession. (Fig. 1)

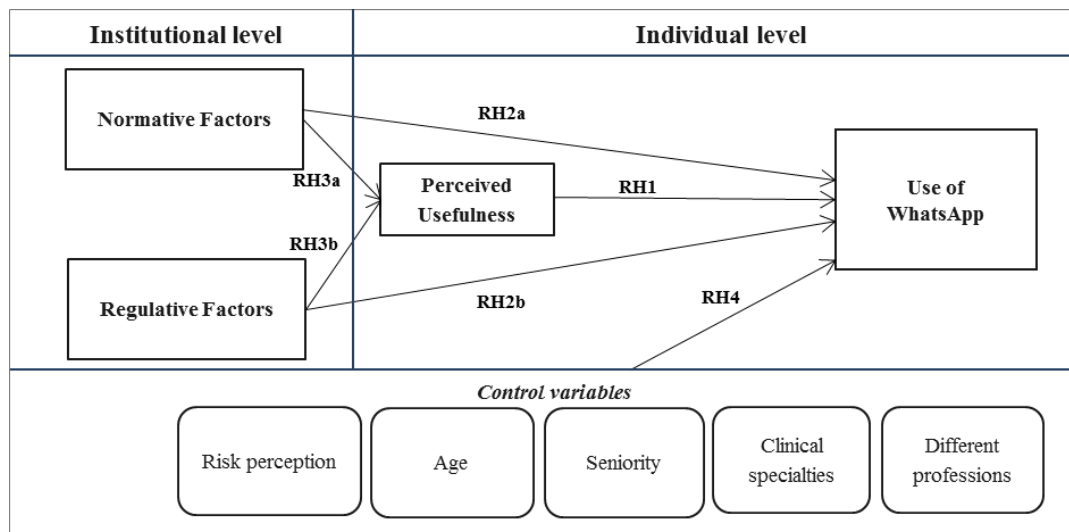


Figure 1. Theoretical Model

According to the research questions and the theoretical model the following research hypotheses (RH) were stated: RH1: Perceived usefulness directly affect the use of WhatsApp; RH2a: Normative factors directly affect the use of WhatsApp; RH2b: Regulative factors directly affect the use of WhatsApp; RH3a: Normative factors directly affect the perceived usefulness of WhatsApp; RH3b: Regulative factors directly affect the perceived usefulness of WhatsApp. RH4: Some control variables (risk perception, age, seniority, clinical specialties and different professions) affect the use of WhatsApp. The hypotheses 3a and 3b are the most relevant for the study, since they explore if and how the individual and institutional

variables interact and which of these variables are dominant. All hypotheses regarding the use of WhatsApp with patients and colleagues, were tested to assess whether or not the interplay between variables is the same.

2.3 Setting and research methodology

A Survey has been designed and administered in the Teaching Hospital Campus Bio-Medico (CBM) of Rome, in Italy. The Hospital CBM was chosen because some of the authors wanted to carry out the study in their own Hospital. It is a constant practice of the CBM Hospital to conduct internal surveys guaranteeing the anonymity of the respondents. The CBM Hospital is part of the University CBM, and it is home of a whole range of clinical, teaching and research activities. The research project has been presented to the Hospital General Management in June 2016, and it has been approved. Moreover, in October 2016 it has been presented to the University Ethic Board, which approved it in November 2016. The units of analysis are the health professionals (nurses and physicians) of the Hospital, which have been selected as participants to the project.

2.3.1 Questionnaire and data collection

The questionnaire has been designed based on the scales identified in literature and reviewed in detail by the group of researchers. Moreover, a pilot test of questionnaire has been carried out before the Survey. The questionnaire consists of three main sections: use of WhatsApp; scales and constructs of the proposed model; control variables and characteristics of the respondent. The use of WhatsApp was evaluated through the following macro-constructs, including 30 items: personal use of WhatsApp in daily life, use of WhatsApp with patients, use of WhatsApp with other healthcare professionals (Mobasheri MH, 2015; O'Reilly MK, 2014). Individual variables were evaluated by 15 item, in particular, the scale for the measurement of perceived usefulness has been adapted from the studies of Venkatesh (Venkatesh V, 2000; Venkatesh V, 2000a; Venkatesh V, 2003; Venkatesh V, 2011). Organizational variables were explored through eleven items related to regulative and normative factors. The scale for the measurement of regulative and normative factors has been adapted from the study of Scott (Scott WR, 2003). Moreover, the risk perception related to the use of WhatsApp in Hospital setting was explored by twelve items. Additional questions have been designed to gather demographic and sample information. All the questionnaire items were explored using a 7 point Likert scale with 1 indicating “totally disagree” and 7 “totally agree”, or 5 Likert-like scale with 1 indicating “never” and 7 “always”. The questionnaires have been introduced in Google forms to be released on an electronical format and they have been sent by personal email to 380 nurses and 250 physicians of the Hospital. Completion rate was assessed weekly. The first re-call has been made one week after the expiration date for compilation. Two or three days after the first follow-up, the second recall has been sent. Two or three days after the second follow-up, the third recall has been sent. The data collected through the online questionnaire have been exported in excel format. Then a data cleaning and analysis has been performed.

2.3.2 Statistical analysis

Statistical analysis was performed using the software Stata 14.1® The internal consistency of the constructs was verified through Cronbach's Alpha. A path analysis was performed in order to test the proposed model; a *p*-value of <0.1 was considered significant. Data related to the use of WhatsApp have been analyzed through descriptive statistics methods.

3. Results

All questionnaires were filled out in a period between February and September 2017, and a total of 191 responses (125 nurses and 66 physicians) had been received (30,3%). Three follow-up were sent to nurses and three to physicians (Table 1). Characteristics of respondents are described in Table 1.

Table 1. Characteristic of respondents

		Frequency	Percentage (%)
Gender	Male	63	33
	Female	128	67
Age	21-30	45	23,6
	31-40	81	42,4
	41-50	43	22,5
	> 50	22	11,5
Profession	Physician	66	34,6
	Nurse	125	65,4
Seniority (years of working experience)	0-10	101	52,9
	11-20	59	30,9
	21-30	19	9,9
	31-40	10	5,2
	> 40	2	1,0

3.1 WhatsApp usage and perceived usefulness

3.1.1 Personal use of WhatsApp

WhatsApp usage in personal life is very common. In particular, nurses and physicians use WhatsApp in order to: participate in group discussion; send private messages to other people; send written messages; send images. Instead, the use of WhatsApp to organize the agenda with others, to send audio note or to share moment of life with others is pretty less frequent. (Table 2)

Table 2. Personal use of WhatsApp

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
I use WhatsApp to participate in group discussions	3,08	1,18	3,24	1,12	-0,16
I use WhatsApp to send private messages to other people	3,98	1,02	4,25	0,91	-0,27
I use WhatsApp to organize my agenda with others	2,77	1,22	3,10	1,19	-0,33
I use WhatsApp to share moments of my life with others	2,95	1,28	3,48	1,17	-0,53
I use WhatsApp to send written messages	3,88	1,12	4,22	0,91	-0,34
I use WhatsApp to send images	3,61	1,12	3,94	0,99	-0,33
I use WhatsApp to send audio notes	2,39	1,15	3,34	1,26	-0,95
I use WhatsApp to send videos	2,65	1,13	3,37	1,26	-0,72
I use WhatsApp even in front of other people	2,58	1,16	2,62	1,26	-0,04
I connect to WhatsApp many times a day	3,65	1,27	3,40	1,10	0,25
<i>Average and Standard Deviation refer to the 5 Likert-like scale' scores: never = 1, rarely = 2, occasionally = 3, often = 4, always = 5.</i>					

3.1.2 WhatsApp usage between health professionals

WhatsApp is used among professionals, in particular by doctors rather than nurses, in order to: share scientific information; manage and share the agenda; communicate about clinical situation; ask for information or give directions; compare clinical data of specific patients; send patient data in form of images or videos; manage clinical trials. The use of WhatsApp to receive patient information from other hospitals is less frequent. (Table 3)

Table 3. Mode of WhatsApp usage between health professionals

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
I use WhatsApp to share scientific information with my colleagues	2,98	1,20	2,60	1,07	0,38
I use WhatsApp for manage and share the agenda with my colleagues	3,03	1,40	3,17	1,05	-0,14
I use WhatsApp for the management of clinical trials	2,00	1,05	1,94	1,05	0,06
I use WhatsApp to communicate with my colleagues about clinical situations, without mentioning specific information of patients	2,58	1,25	1,79	1,06	0,79
I use WhatsApp to ask for information or give directions to my colleagues, without mentioning specific information of patients	2,62	1,26	2,23	1,17	0,39
I use WhatsApp to compare clinical data of specific patients with my colleagues, using patient data	1,97	1,19	2,05	1,15	-0,08
I use WhatsApp to send patient data to my colleagues, in form of images or videos	1,95	1,09	1,56	0,99	0,39
I use WhatsApp to receive patient information from other hospitals	1,77	1,13	1,31	0,82	0,46
<i>Average and Standard Deviation refer to the 5 Likert-like scale' scores: never = 1, rarely = 2, occasionally = 3, often = 4, always = 5.</i>					

3.1.3 Perceived benefits about WhatsApp usage between health professionals

Nurses and physicians report many perceived benefits related to the use of WhatsApp. In particular, they suggest that the use of WhatsApp: improve communication; increase efficiency; can reduce the costs in the Hospital; is time saving; improve the sharing of clinical and scientific knowledge; might improve performances of research and teaching activities. At the same time some respondents suggest that the use of WhatsApp at work can reduce productivity (eg: *I am distracted by other factors that do not concern my job*), or can increase the workload. (Table 4)

Table 4. Perceived threats about WhatsApp usage between health professionals

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
I am convinced that the use of WhatsApp improves communication	4,72	1,49	4,41	1,48	0,31
Using WhatsApp lets you know if the messages have been read by colleagues	5,02	1,26	4,66	1,53	0,36
To use WhatsApp for work is time saving because it is faster than phone or mail	4,65	1,58	4,41	1,66	0,24
I am convinced that if everyone used WhatsApp there would be a greater and more effective sharing of clinical knowledge	3,59	1,69	3,68	1,72	-0,09
The use of WhatsApp can greatly contribute to reducing the costs in the Hospital	4,00	1,53	3,55	1,54	0,45
The use of WhatsApp has the limit of the need for internet connection	4,71	1,52	4,11	1,74	0,6
The use of WhatsApp at work reduces my productivity (eg: I am distracted by other factors that do not concern my job)	3,52	1,79	4,27	1,65	-0,75
The use of WhatsApp positively affects my research activity (ie: it is easier to share data and results)	3,55	1,52	3,82	1,71	-0,27
The use of WhatsApp positively affects my teaching activity	3,36	1,46	3,96	1,59	-0,6
The use of WhatsApp for communication between health workers can increase the workload	3,50	1,70	2,79	1,69	0,71
<i>Average and Standard Deviation refer to the 7 Likert scale' scores: totally disagree=1, strongly disagree=2, quite disagree=3, neither agree nor disagree=4, quite agree=5, strongly agree=6, totally agree=7.</i>					

3.1.4 Perceived threats about WhatsApp usage between health professionals

Only few nurses and physicians report that the use of WhatsApp for clinical issue is safe and it does not involve risks. Most respondents agree that: sending clinical data via WhatsApp involves risks for health professionals; the use of WhatsApp involves risks related to privacy and data protection; the use of WhatsApp carries the risk of uncontrolled spread of sensitive data; communicating through WhatsApp involves clinical risks as it is not documented within the medical record. (Table 5)

Table 5. Perceived threats about WhatsApp usage between health professionals

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
The use of WhatsApp to communicate patient data with other health professionals is safe and does not entail risks	3,17	1,55	2,85	1,62	0,32
Sending clinical data via WhatsApp involves risks for health professionals	5,00	1,32	4,94	1,50	0,06
The use of WhatsApp involves risks related to privacy and data protection	5,32	1,34	5,34	1,40	-0,02
The use of WhatsApp carries the risk of uncontrolled spread of sensitive data	5,02	1,45	5,36	1,48	-0,34
To communicate through WhatsApp involves clinical risks as it is not documented within the medical record	5,28	1,55	5,34	1,62	-0,06
<i>Average and Standard Deviation refer to the 7 Likert scale' scores: totally disagree=1, strongly disagree=2, quite disagree=3, neither agree nor disagree=4, quite agree=5, strongly agree=6, totally agree=7.</i>					

3.1.5 WhatsApp usage with patients

Some physicians (26%) report that often patients ask them to use WhatsApp in order to facilitate communication. Instead, only few physicians suggest to patients the use of WhatsApp to communicate with them. This is probably related to the age of the patients; in fact, young people are more likely to use this kind of approach rather than the elderly. Occasionally this application is used in order to organize the schedule of appointments with patients; rarely to prescribe drugs or treatments, to monitor clinical conditions of chronic patients and to monitor the effects of certain drugs. More frequent is the use of WhatsApp to answer urgent questions. Only few physicians refer to make clinical decisions based on the information received through WhatsApp and without further patient assessment. Some physicians refer that patients send images or videos via WhatsApp to get an evaluation before a visit, and send photos or videos to get an evaluation without having a scheduled visit. Nurses' behaviors are very different: almost none of the interviewed nurses use WhatsApp to communicate with patients. Only few nurses report that patients themselves ask them to use WhatsApp in order to facilitate communication, and the number of nurses who suggest their patients to use WhatsApp is less than 5%. (Table 6)

Table 6. Mode of WhatsApp usage with patients

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
Some of my patients ask me to use WhatsApp to communicate with them	2,65	1,26	1,21	0,53	1,44
I suggest to some of my patients to use WhatsApp to communicate with me	1,79	1,21	1,11	0,42	0,68
I use WhatsApp to organize the agenda of appointments with my patients	1,77	1,09	1,12	0,43	0,65
I use WhatsApp to send to my patients the results of diagnostic tests	1,32	0,77	1,05	0,28	0,27
My patients send me pictures or videos via WhatsApp to get an evaluation before a visit	2,33	1,17	1,11	0,48	1,22
My patients send me via WhatsApp photos or videos to get an evaluation without having a scheduled visit	2,23	1,21	1,11	0,48	1,12
I use WhatsApp to prescribe drugs or treatments to my patients	1,29	0,65	1,07	0,45	0,22
I use WhatsApp with chronic patients to monitor their clinical conditions	1,62	0,94	1,07	0,32	0,55
I use WhatsApp with patients to monitor the effects of certain drugs	1,45	0,91	1,05	0,28	0,4
I use WhatsApp to answer urgent questions that my patients ask me	1,85	1,00	1,15	0,53	0,7
I make clinical decisions based on information received via WhatsApp without further patient assessment	1,27	0,69	1,10	0,47	0,17
<i>Average and Standard Deviation refer to the 5 Likert-like scale' scores: never = 1, rarely = 2, occasionally = 3, often = 4, always = 5.</i>					

3.1.6 Perceived benefits related to WhatsApp usage with patients

Nurses and physicians report some perceived benefits related to the use of WhatsApp with patients: its usage facilitates the doctor-patient relationship and allows to effectively exchange information with the patient. Moreover, they reported that using WhatsApp to monitor patients' clinical conditions increases the likelihood of recovery of their clinical situation. It is also reported that the evaluation of images or videos sent via WhatsApp is not sufficient to make a diagnosis. (Table 7)

Table 7. Perceived benefits related to WhatsApp usage with patients

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
The evaluation of images or videos sent via WhatsApp is not sufficient to make a diagnosis	5,03	1,80	4,27	1,69	0,76
Using WhatsApp to monitor patients' clinical conditions increases the likelihood of recovery of their clinical situation	3,74	1,84	4,50	1,86	-0,76
Use of WhatsApp facilitates the doctor-patient relationship	3,98	1,64	3,97	1,82	0,01
Using WhatsApp in my work allows me to effectively exchange information with the patient, thus avoiding a medical examination	2,76	1,57	2,92	1,84	-0,16
Average and Standard Deviation refer to the 7 Likert scale' scores: totally disagree=1, strongly disagree=2, quite disagree=3, neither agree nor disagree=4, quite agree=5, strongly agree=6, totally agree=7.					

3.1.7 Perceived threats related to WhatsApp usage with patients

However, professionals also report the main perceived threats related to the use of WhatsApp in Hospital setting. In particular they suggest that the use of WhatsApp with patient: involves risks in general; could generate misunderstandings; implies the risk of incorrect diagnosis or clinical decisions; carries the risk of incorrect assessments; entails risks related to privacy and data security; carries the risk of uncontrolled disclosure of sensitive data; implies clinical risks as it is not traced within the clinical documentation; carries the risk of compromising the relationship between patient and physician and involves risks for health professionals. Moreover, professionals suggest that WhatsApp usage in clinical setting is risky because no guidelines and recommendations are available about this kind of communication, and that the transmission of patient's sensitive data through WhatsApp should provide patient's informed consent for data treatment. (Table 8)

Table 8. Perceived threats related to WhatsApp usage with patients

	Physicians (P) (n=66)		Nurses (N) (n=125)		Delta (Av.P – Av.N)
	Av	SD	Av	SD	
The use of WhatsApp for communication between patients and health professionals is safe and does not involve risks	2,65	1,34	2,57	1,52	0,08
The use of WhatsApp for communication can generate misunderstandings with the patient	4,91	1,46	5,03	1,40	-0,12
Sending clinical-care data via WhatsApp involves risks for the patient	4,82	1,36	4,83	1,51	-0,01
The use of WhatsApp involves the risk of incorrect clinical evaluations	5,11	1,47	5,19	1,40	-0,08
The use of WhatsApp involves the risk of incorrect diagnosis and clinical decisions	5,05	1,47	5,02	1,48	0,03
The use of WhatsApp involves the risk of compromising the patient-physicians relationship	4,14	1,74	5,02	1,55	-0,88
The use of WhatsApp for the transmission of sensitive data with the patient should provide consent for personal data treatment by the patient	5,13	1,60	5,44	1,56	-0,31
The use of WhatsApp in the clinical setting is risky because no guidelines and recommendations are available about the safe mode of use and transmission of data	4,80	1,76	3,74	1,81	1,06
Average and Standard Deviation refer to the 7 Likert scale' scores: totally disagree=1, strongly disagree=2, quite disagree=3, neither agree nor disagree=4, quite agree=5, strongly agree=6, totally agree=7.					

3.2 Testing the theoretical model

3.2.1 Questionnaire's constructs internal consistency

The internal consistency of the questionnaire's constructs was verified through Cronbach's Alpha analysis (Table 9). Values greater than or equal to 0.7 were considered acceptable.

Table 9. Questionnaire's constructs validity analysis

Variable/Macro-item	Cronbach's Alpha
Use	0,92
Perceived Usefulness	0,81
Normative Factors	0,79
Regulative Factors	0,77
Perceived Risk	0,93

3.2.2 Determinants of current behaviors

Thanks to a Path Analysis performed within the SEM builder environment it has been possible to verify the proposed model and to evaluate the main determinants (individual and institutional) of the use of WhatsApp by the doctors and nurses included in the study. Results suggest that regulative factors do not have an impact on the use WhatsApp with patients or colleagues, while normative factors have a direct impact on perceived usefulness of WhatsApp with patients and colleagues. Moreover, perceived usefulness is directly related to the use of WhatsApp with both patients and colleagues, and risk perception is negatively related to the use of WhatsApp with patients. (Table 10)

Table 10. Determinants of current behaviors

Research Hypotheses	Use of WhatsApp between professionals	Use of WhatsApp with patients
RH1: Perceived Usefulness directly affect the use of WhatsApp.	Coeff= 0,27 p**=0,022	Coeff= 0,10 p**=0,022
RH2a: Normative factors directly affect the use of WhatsApp.	p=0,723 NS	p=0,25 NS
RH2b: Regulative factors directly affect the use of WhatsApp.	p=0,436 NS	p=0,582 NS
RH3a: Normative factors directly affect the perceived usefulness of WhatsApp.	Coeff=0,58 p***=0,00	Coeff=0,58 p***=0,00
RH3b: Regulative factors directly affect the perceived usefulness of WhatsApp.	p=0,70 NS	p=0,68 NS
RH4: Risk perception affect the use of WhatsApp.	p*=0,095 Coeff. =-0,15	p=0,884 NS
RH4: Other control variables (Age, seniority, clinical specialties and different professions) affect the use of WhatsApp.	NS	NS
*p value<0.1, **p value<0.05, ***p value<0.005 NS=Not Significant		

4. Discussion

The findings shows an interplay between institutional and individual factors in determining the use of WhatsApp in healthcare context between healthcare professionals and with patients. In particular, individual factors play a key role as determinant of the use of WhatsApp; healthcare professionals use this technology mainly based on the perceived usefulness (p=0.022). Instead, institutional factors play a secondary role; they do not have a direct influence on the use of WhatsApp, but they always act through individual factors. One of the most interesting finding is that, although professionals consider WhatsApp not safe, they use it in their clinical practice with colleagues and patients. This is an issue mainly related to the phenomenon of “back door adoption”, innovations brought by the healthcare professionals without any formal approval or assessment from top managers about the opportunities and risks that these innovation

might bring along with them. In fact, most respondents agree that using WhatsApp for clinical issue between professionals and with patients involve the following risks or disadvantages: not safe for health professionals; uncontrolled spread of sensitive data (Dhuvad JM, 2015); it is not documented within the medical record (Jagannathan M, 2013; Migliore M, 2015); possible misunderstandings with patients (Jagannathan M, 2013; Migliore M, 2015); incorrect diagnosis or clinical decisions; incorrect assessments; compromising the relationship between patient and physician (Choudhari P, 2014); not part of the medical records (Jagannathan M, 2013; Migliore M, 2015); possible increased work (Gulacti U, 2016). Moreover, professionals suggest that WhatsApp usage in clinical setting is risky because no guidelines and recommendations are available about this kind of communication, and that the transmission of patient's sensitive data through WhatsApp should provide patient's informed consent for data treatment. The findings confirm also that WhatsApp is widely used in the hospital context. (Boulos MNK, 2016) Both doctors and nurses use it to share data and information with each other in the teamwork, and doctors mostly use it to communicate with patients. Risk perception is directly related to the use of WhatsApp between colleagues ($p=0.095$). Some of the main perceived benefits of WhatsApp usage in healthcare setting are related to an improvement in communication (Petruzzi M, 2016) and in the sharing of clinical and scientific knowledge; a time saving (Gulacti U, 2016; Boulos MNK, 2016; Graziano F, 2015; Martyn-Hemphill C, 2015); an increase in efficiency; an improvement in research and teaching activities' performances.

5. Conclusion

This study furthers current knowledge about the adoption of digital innovations in a professional setting with a focus on “back door” adoption. In particular, by combining institutional and individual factors in a coherent theoretical framework, we showed the interplay between different factors as well as their independent effect on the adoption of digital innovations. Moreover, the findings provides hospital managers with insights about the factors that promote/inhibit the adoption of “back door” innovations such as WhatsApp that can help them to manage this phenomenon and implementing adequate strategies to exploit its potential increasing at the same time the level of safety for the patients. It would be desirable to continue the study by involving a larger number of Hospitals to test the model and make the data more generalizable.

5.1 Limitations

The results of the study are valid within several limitations. First, it was a single center survey conducted with a relatively small number of health professionals, although they were representative of all the Hospital's departments. It has not been possible to carry out a multicenter study immediately due to the lack of availability in the literature of an already validated questionnaire. Moreover, the number of nurses who answered the questionnaire was higher than physicians, even if, despite the relatively small response rate, the number of respondents was high. This was probably due to the size of Hospital and to the accessibility to personal email of health professionals.

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